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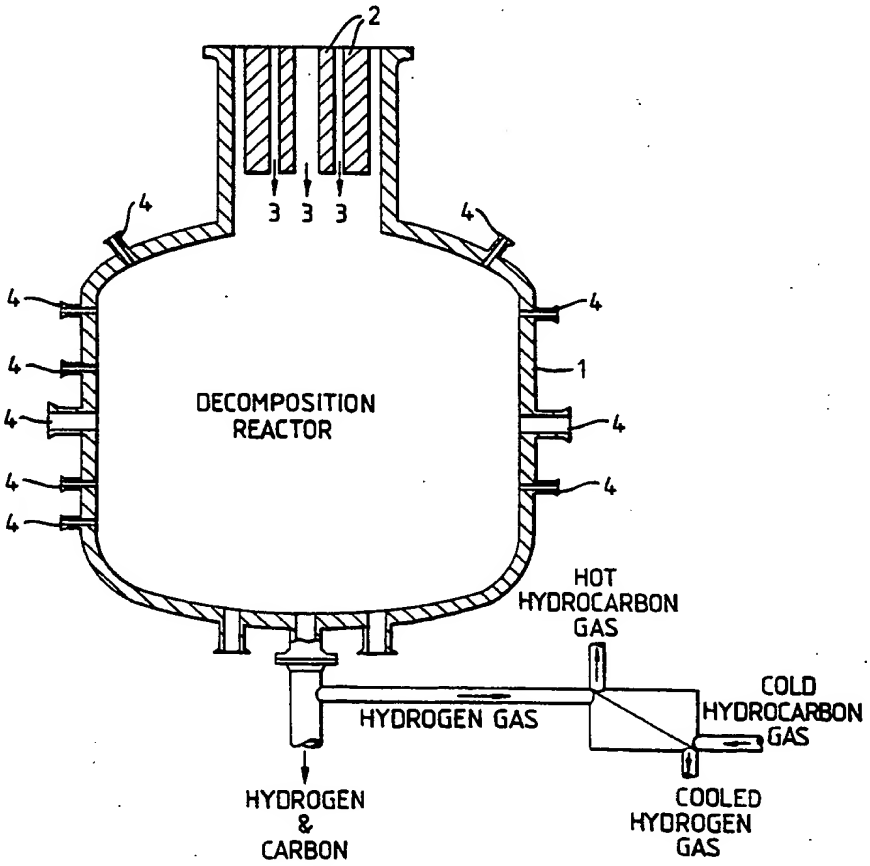
(54) Title: DECOMPOSITION REACTOR

(57) Abstract

A decomposition reactor for installation in connection with a thermal decomposition chamber for hydrocarbon gases, especially a plasma torch (2), is designed in the form of a defined, insulated chamber, with an inlet for admixtures/gases in the walls of the reactor space. In order to improve the control of the products produced, the supply channels (4) in the walls of the reactor (1) are provided with channels for introducing hydrocarbon gases of the same kind as the main medium introduced at a temperature of between 1000 and 2000 °C in the upper region of the space. Hydrocarbon gas of a lower temperature is introduced at one or more points further down in the reactor. A method for the operation of such a decomposition reactor for the production of carbon black with defined physical properties, is also described.



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Decomposition Reactor

The invention relates to a decomposition reactor for installation in connection with a thermal decomposition chamber for hydrocarbon gases, especially a plasma torch, wherein the reactor is designed as a defined, insulated chamber with an inlet for admixtures/gases through the walls of the reactor chamber. In connection with the decomposition of hydrocarbons in plasma torches, a method is known for providing reactor chambers for further processing of the reaction products or decomposition products. Such reactors are known, e.g., for the production of acetylene. Reactor chambers have also been used in connection with the production of carbon black and hydrogen where special temperatures have been set in the reactor in order to obtain a special characteristic for the end product.

A method is also known for introducing special gases along the reactor walls in order to prevent the formation of deposits and in order to cool the wall areas.

However, in none of these known reactors has a sufficiently even quality been achieved in the produced carbon black with regard to its structure. This is probably due to the formation of various arbitrary temperature zones in the reactor, which result in an uncontrolled carbon development and thereby a relatively unspecified quality in the final product. By introducing gas along the reactor wall in order to prevent the formation of deposits, similar side effects have occurred as well as the establishment of temperature zones which have had a detrimental effect on the products. Without such gases problems have very frequently arisen with deposits on the reactor walls which have resulted in stoppages for scraping, in order to make the reactor operational again. These problems have led to reactors generally having been operated intermittently with the consequent increase in operational costs.

The object of the present invention is to provide a reactor which makes it possible to have greater control over the products obtained. A further object of the invention is to provide a reactor which can be kept in continuous operation and where strict control is obtained over the temperature development throughout the entire reactor, where it is possible to control any admixtures and thereby obtain a product with a desired quality and physical properties.

These objects are achieved with a decomposition reactor of the type described in the introduction, which is characterized by the features in the patent claims presented.

With the reactor according to the invention one makes use of the possibility of controlling both the supply of additional starting materials in the actual reactor chamber and of controlling the temperature conditions. The possibility is also offered of supplying desired admixtures to the final products from the reactor. It has surprisingly been discovered that by the admixture of additional starting materials, i.e. hydrocarbon gas in the reactor chamber, control can be obtained of the structure of the produced carbon black. The hydrocarbon which is decomposed in the reactor is preferably a natural gas or methane, which constitutes a very pure hydrocarbon mixture, so that completely pure carbon and hydrogen are principally obtained in the reactor. The carbon black which is formed in the torch flows into the reactor chamber and is distributed therein. According to the invention additional natural gas or methane is supplied which can be preheated to a desired temperature, e.g. through an inlet in the reactor wall or heat exchanged with the product stream flowing out of the reactor space. This methane is decomposed in the reactor in a similar manner to the methane which comes from the torch, but since a temperature difference exists here, these already formed carbon particles will act as nuclei on which the decomposed carbon supplied through the reactor side wall will be deposited and

grow into larger soot particles or carbon particles. This deposit or growth of carbon particles can be controlled by controlling the quantity of hydrocarbons supplied in the reactor chamber, by controlling the feed temperature for the additional carbon material and by admixture in several zones with different temperatures, thus causing the development of a structure on the nuclei of carbon from the plasma torch. This deliberate control of the temperature conditions, the admixture and admixture point offers the possibility of adjusting the exact structure conditions desired for the carbon black produced.

The control mechanism in the reactor chamber can also be of such a nature that it may be desirable not to supply additional hydrocarbon gas in the reactor chamber, but only to influence the temperature in such a manner that the produced carbon black retains its structure, by letting it cool at a desired rate on its way through the reaction chamber so that it is not influenced uncontrollably or detrimentally by the temperature change.

In the reactor chamber there may similarly be introduced admixtures which will also be deposited on the carbon black and provide desired effects with regard to the areas of application of the carbon black.

The invention will now be described in more detail by means of an embodiment which is illustrated purely schematically in the drawing, which illustrates the principles of the design of the reactor according to the invention.

In the drawing the basic concept of a reactor chamber is illustrated, which should enable a person skilled in the art to develop the technical solutions with the aid of well known means. As illustrated here the nature of the reactor chamber is of the same principle as that described in the applicant's

Norwegian patent application 91 4904. The actual decomposition reactor is generally indicated by 1. Plasma torches are indicated by 2 and the decomposition products entering the reactor, carbon black and hydrogen are generally indicated by 3, indicated here by arrows. The decomposition products will distribute themselves in the reactor and the carbon component will be influenced and developed by the prevailing temperature conditions.

In the side walls of the reactor there are provided lead-in pipes for additional hydrocarbon gases of the same kind as the main medium introduced. These gases are preheated and may have a temperature between 1000 and 2000°C in the upper region of the space while cooler gases can be introduced further down in the reactor. The lead-in pipes are indicated by 4. Through these lead-in pipes or nozzles admixtures can also be supplied or only heating gases such as hydrogen can be supplied here in order to maintain special temperature conditions in the reactor. The hot hydrocarbon gases which flow into the reactor from the side will also be decomposed and the produced carbon black will be deposited on the carbon black from the plasma torch forming nuclei, these again growing into particles. When setting the temperature for the introduction of the additional gases, the particle growth can therefore be controlled and thereby the physical properties of the produced carbon black can also be controlled. This can be done in the various zones along the reactor or by special settings of the temperature. Admixtures which are introduced through such lead-in pipes will also be deposited on the carbon black, thus providing the desired side effects. If special qualities are desired based on special temperature conditions, the supply of hydrocarbons through the lead-in pipes may also be omitted, and provision made only for the maintenance of specific temperature zones for the decomposition products from the plasma torch.

Thus it should be clear that by means of the reactor according to the invention it is possible to achieve special structures and physical properties of the produced carbon black, thus making it possible to obtain a special product which is adapted to suit subsequent applications.

The above description covers only the principles of the construction of such a reactor and a method for the production of special qualities of carbon black. It should be obvious from the above that many modifications will be possible within the scope of the invention.

PATENT CLAIMS

1. A decomposition reactor for installation in connection with a thermal decomposition chamber for hydrocarbon gases, especially a plasma torch (2), wherein the reactor (1) is designed in the form of a defined, insulated chamber, with an inlet for admixtures/gases in the walls of the reactor space, characterized in that the supply channels (4) in the walls of the reactor (1) include channels for introducing hydrocarbon gases of the same kind as the main medium introduced at a temperature of between 1000 and 2000°C in the upper region of the space, and where hydrocarbon gas of a lower temperature is introduced at one or more points further down in the reactor.

2. A decomposition reactor according to claim 1, characterized in that the introduction devices (4) for gas in the walls of the reactor (1) are equipped with temperature control devices for the setting of desired temperatures in the reactor.

3. A decomposition reactor according to claim 1, characterized in that the lead-in pipes (4) are connected to conduits with valves for alternative supply of heating medium, preferably hydrogen, or hydrocarbon gas.

4. A method for the operation of a decomposition reactor for the production of carbon black with defined physical properties, where the reactor (1) is equipped with supply channels (4) in its reactor walls, and where the reactor (1) is connected to a plasma torch (2),
characterized in that in addition to the decomposition products (3) from the plasma torch (2) additional hydrocarbon gas and/or heating gas are introduced from the lead-in pipes in the side walls of the reactor (1), the supply of additional hydrocarbon gas/heating gas being controlled in order to obtain a predetermined temperature distribution in the reactor (1) chamber, and

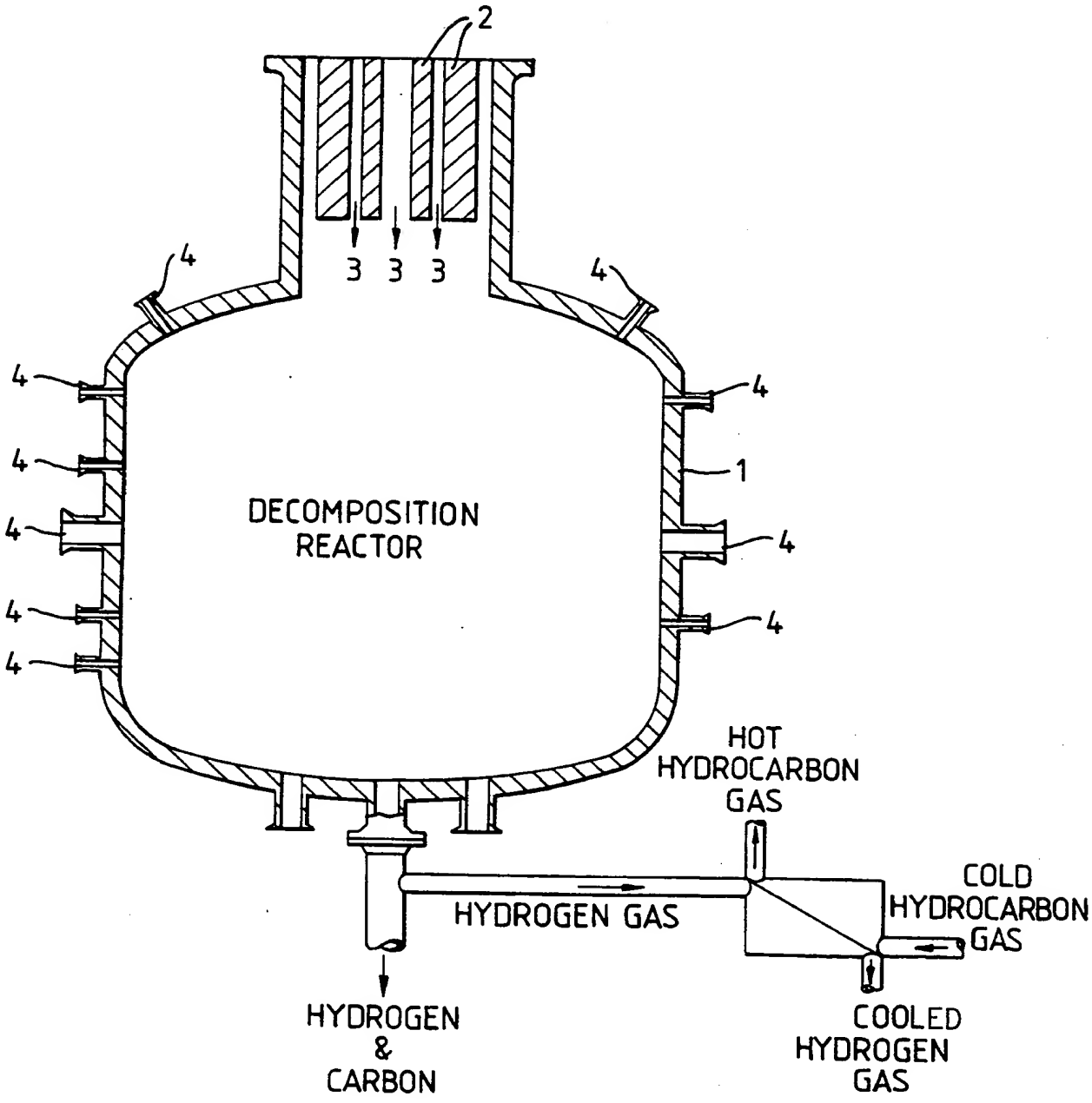
with the supply of defined quantities of hydrocarbon gases through the lead-in pipes (4), for decomposition of the supplied gases into carbon black and hydrogen, and that the carbon black from the lead-in pipes (4) is deposited on the carbon black from the plasma torch (2) and develops particles with the desired properties.

5. A method according to claim 4, characterized in that through the lead-in pipes (4) there is supplied only heated hydrocarbon gases of the same kind as are supplied through the plasma torch (2).

6. A method according to claim 4, characterized in that only heating gases are introduced through the lead-in pipes (4).

7. A method according to claim 4, characterized in that there is introduced a hydrocarbon gas/heating gas at a temperature which decreases with the increase in the distance in the reactor chamber from the plasma torch (2).

Fig.1.



INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 93/00056

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: C09C 1/48
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: C09C, C01B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB, A, 1400266 (GOSUDARSTVENNY NAUCHNO-ISSLEDOVATELSKY ENERGETICHESKY INSTITUT IMENI G.M. KRZHIZHANOVSKOGO), 16 July 1975 (16.07.75), page 2, line 1 - line 50; page 2, line 75 - line 95	1,4-5
Y	EP, A1, 0411160 (NIPPON STEEL CHEMICAL CO. LTD.), 6 February 1991 (06.02.91), page 7, line 11 - line 39, figure 6	1,4
Y	US, A, 4213939 (THEODORE A. RUBLE), 22 July 1980 (22.07.80), column 3, line 14 - line 24; column 4, line 45 - line 56, figure 1	1,4

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
21 June 1993	09 -07- 1993
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Britt-Marie Lundell Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP, A2, 0392121 (COLUMBIAN CHEMICALS COMPANY), 17 October 1990 (17.10.90), column 7, line 32 - line 40, figure 1	1,4

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INTERNATIONAL SEARCH REPORT

Information on patent family members

28/05/93

International application No.

PCT/NO 93/00056

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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EP-A1- 0411160	06/02/91	CN-A- 1045593	26/09/90
		JP-A- 3223367	02/10/91
		WO-A- 9010038	07/09/90
US-A- 4213939	22/07/80	US-A- 4289743	15/09/81
EP-A2- 0392121	17/10/90	AU-A- 4919090	11/10/90
		CA-A- 2005697	10/10/90
		JP-A- 3033167	13/02/91